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Uncertainty in climate policy – impacts on market mechanisms

Alexander Vasa, Axel Michaelowa*

*Center for Comparative and International Studies, University of Zurich, Affolternstrasse 56, 8050 Zurich, Switzerland,axel.michaelowa@pw.uzh.ch

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1. Introduction

In terms of geological shifts in climate, climate policy is a very young field. However, during the last two decades it has developed at a rapid pace. In 1987, the Brundtland Report first used the concept of sustainable development, followed in 1988 by the first meeting of the Intergovernmental Panel on Climate Change (IPCC) in Toronto. The establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 marked the birth of global climate policy.[1] For the first time in history governments of almost all nations gathered to discuss the effects and consequences of and measures to be taken against global warming and agreed on the principle of "common but differentiated responsibilities"[2]. The first decade of climate policy culminated in 1997 in the signing of the Kyoto Protocol, in which industrialized countries (37 so-called "Annex B countries"), agreed to reduce anthropogenic emissions of six greenhouse gases (GHGs) by 5.2% below 1990 levels during the Kyoto commitment period, 2008-2012 (Article 3, UNFCCC, 1997).[3] At the same time, developing countries, agreed to provide GHG inventory reports. As abatement of a ton of CO_2 eq. is equally effective for the global climate irrespective of the location of abatement,

[1] The UNFCCC was signed May 9th, 1992 as part of the UN Conference on Development and Environment (UNCED) in Rio de Janeiro and entered into force March, 1994. By early 2008, 192 nations have ratified the UNFCCC, while 154 nations had signed the UNFCCC in 1992 in Rio de Janeiro.

[2] This was done by differentiating countries into "Annex I", i.e. industrialized countries and "Non-Annex I", i.e. developing countries.

[3] GHGs covered under the Kyoto Protocol are carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF_6). All GHGs can be restated in terms of CO_2-equivalent (CO_2 eq.) by multiplying their quantity in tons with the 100 year global warming potential (GWP) of the respective greenhouse gas. Until October 2008, the Kyoto Protocol had been ratified by 182 countries.

according to economic theory emissions should be reduced where the marginal cost of abatement is lowest (Dales, 1968; Coase, 1960). To reduce costs of compliance for Annex B countries, four flexible market mechanisms have been introduced to increase the efficiency of emission reduction opportunities by global trading:

- Target reallocation (Bubble) (Article 4);[4]
- Joint Implementation - JI (Article 6);
- Clean Development Mechanism – CDM (Article 12); and
- International Emissions Trading – IET (Article 17)[5].

International Emissions Trading (IET) allows governments of countries with commitments to sell unused shares of their emissions budgets, so called Assigned Amount Units (AAUs), to other countries that want to use more AAUs than they have been assigned in the Kyoto Protocol. The second mechanism, Joint Implementation (JI), permits the generation of emissions credits through emission reduction projects in an Annex-I country. These credits can be used by the acquiring (Annex B) country to fulfil its Kyoto commitments; an equivalent amount has to be deducted from the emissions budget of the country hosting the projects to avoid double counting (Michaelowa, 1995; Metz, 1995, Geres and Michaelowa, 2002). The Clean Development Mechanism (CDM) allows projects that reduce emissions in non-Annex I countries that do not have an emissions budget to generate emission credits that can be used by countries that have commitments. Finally, the CDM is the only instrument of the Kyoto Protocol that started before 2008. CDM credits (so-called Certified Emission Reductions, CERs) can be generated from 2000 onwards if early and serious consideration of the CDM in the planning of the project can be proven (Michaelowa et al. 2007). Due to the fact that all actors involved in CDM projects have an incentive to overstate emission reductions, there is a detailed body of rules whose implementation is checked through independent audits. A cornerstone of the rules is the principle of additionality, i.e. that a CDM project would not have happened without the CER incentive[6].

The Kyoto Mechanisms are the most innovative feature of the Kyoto Protocol and therefore particularly prone to impacts of uncertainty regarding general stability of climate policies,

[4] This mechanism, although often omitted in the list of flexible mechanisms, is used by the European Union to achieve the emission targets as a group rather than as individual countries.

[5] There is a wealth of abbreviations in the Kyoto carbon market. For convenience, the most frequently used terms can be found in the Annex to this paper.

[6] The most recent version of the "Tool for the demonstration and assessment of Additionality" has been approved by EB 39 in its fifth version.

rules for mechanism implementation and performance of projects under the project-based mechanisms. We focus on the CDM to illustrate the effect of those uncertainties. First, we identify sources of uncertainty at the policy, project and institutional level. We then look at their impact on the Kyoto market as a whole and provide recommendations for improvement. Section 2 deals with uncertainty in international climate policy and domestic climate policy of large players, especially regarding the lifetime of the Kyoto Protocol regime and domestic incentives for use of certified emission reductions. Section 3 gives a brief overview of the current CDM market and introduces the effect of real and perceived policy uncertainties on CER prices. Furthermore, the quality and performance of CDM projects, both of which are major determinants driving the environmental integrity and effectiveness of the mechanism are analyzed as an additional factor. Performance of the CDM in general and of specific project types in particular can give substantial price signals as some domestic climate policy instruments only accept certain types of CERs. Section 4 assesses external and internal actors in the Kyoto system and analyses how these actors influence the price of carbon. Moreover, this section makes recommendations to enhance transparency and regulatory stability. Section 5 concludes the chapter.

2. Uncertainty in International Climate Policy

The key uncertainty on the international level is whether an international regime is applicable and binding, and for how long it lasts.

The Kyoto Protocol initiated the "period orientation" of climate policy. The Kyoto commitment period runs from 2008 – 2012. For the time leading to and including this period, market participants, governments and institutions have a certain degree of planning security. The five year interval was chosen on the basis that a usual business cycle needs about the same time to complete. It is intuitive that the length of climate regime period is positively correlated with planning certainty for market participants. The fifteen year time-span from the drafting of the Kyoto Protocol until the end of the first commitment period in 2012 was believed to be an adequate investment horizon for businesses. But nobody expected the uncertainty of entry into force - for an interval of seven years between 1997 and the final ratification by Russia[7] in November 2004, it was not clear if the Kyoto Protocol were ever to

[7] The ratification by the Russian Federation was required to fulfil the condition that more than 55% of CO_2 emissions from Annex-I countries are included in the ratifying group (Article 25, KP). This was due to the refusal of the US to ratify, as the US was responsible for 36% of the emissions.

enter into force[8]. The long waiting period for entry into force was due to the unwillingness of the US to ratify the Protocol, which then gave Russia a de facto veto power. Thus, even if decisions have already been taken on the international level, domestic interest groups and political interests of big emitters have considerable impact on the implementation of the international climate policy regime (for Russia see Michaelowa and Koch 2002; Burtraw et al. 2001).[9]

As the Kyoto Protocol only lasts until 2012, the current uncertainty due to the lack of a post-2012 climate policy regime increasingly becomes similar to the situation before the Russian ratification. The "Bali Action Plan" foresaw that a final treaty would be finished during the 15th Conference of the Parties (COP-15) 2009 in Copenhagen but this was not achieved. The key issue is stringency of emission targets. The Bali Action Plan contained a target corridor of 25-40% emissions reduction by 2020 for industrialized countries. The EU has proposed a 30% reduction target for itself if other industrialized countries embark on similar commitments. The Copenhagen Accord and the recent Cancun Agreement provide a framework for bottom-up country pledges by industrialized countries and advanced developing countries but no legally binding commitments.

If market participants expect that the post-2012 Copenhagen treaty is weak in terms of emission reduction commitments, they have little incentive to engage in "early" action now and thus delay emission reducing investments. If on the other side actors expect stringent and enforceable emission targets, emitters have incentives for domestic reductions and purchasing emission reduction credits from the Kyoto Mechanisms.

Similarly, big players such as the European Union have a large influence not only during the negotiations of the regime but also on setting incentives for the carbon market. The EU set up the only really large domestic policy with a concrete incentive for the Kyoto Mechanisms – the European Union Emissions Trading Scheme (EU ETS), which started operating in 2005 and which has been linked to CDM and JI. In 2009, over 6 billion EU allowances (EUAs) were traded at a turnover of € 89 billion (Kossoy and Ambrosi 2010). In part II, we will discuss the key role of the emission allowance price for the pricing of certified emission reductions. In this context, a recent decision by the EU to severely restrain CER imports has

[8] Interestingly, 39 CDM projects were submitted before Russia´s ratification, showing that some market actors were willing to take up the Kyoto risk.

[9] Michaelowa and Koch (2002) examine Russia's possible reasons, including interest group rent seeking and Duma power issues, for not having ratified the protocol despite generous counting of sinks (and doubling of these sinks in Marrakech) and allocation of "hot air" permits (Michaelowa and Koch, 2002 pp. 563). Bernard, Paltsev, Reilly, Vielle and Viguier (2003) show in their paper using computable general equilibrium models how Russia faces a trade-off to maximise their revenue from emission permits versus the revenue from fossil energy exports.

had a negative influence on the CER price. The EU is clearly aware of its key role in the Kyoto Market and willing to use this as a negotiation tool. This increases uncertainty in the market, as the market is "taken hostage" of political interests. As the Kyoto Mechanisms and the resulting carbon market have entirely been established by government intervention, political decisions can in principle create new demand and similarly take away demand with a stroke of a pen (Michaelowa, 1998). For an analysis of the impacts of interest groups on such decisions see part III. A nice example of the impact of interest groups on policy decisions with a heavy impact on the carbon market can be seen in the US. Until 2001 there was considerable interest by US businesses in the carbon market and the Kyoto Mechanisms, which essentially had been included in the Kyoto Protocol on the request of the United States[10]. However, when President Bush refused ratification, US businesses specializing in the carbon market lost momentum and eventually European providers took the lead. As the few US businesses remaining active focused on domestic offsets only, they see the CDM as a competitor and therefore oppose it. At the same time, as European investors and carbon-related businesses have already made substantial investments in the CDM market that would be worthless if the CDM was abolished they want to keep the system as it is[11].

The aspect of uncertainty about the future post-2012, even though the current CDM market is blooming, leads to a saw-tooth curve of uncertainty in which uncertainty about the potential follow-up post-2012 regime increases when approaching the end date of a period, without another follow-up treaty being decided. Similarly, uncertainty decreases when approaching the start date of a new period as more information enters the market and expectations are formed. This uncertainty is reflected in the volatility of the price for carbon. An optimal solution for the above problem is a series of commitment periods with established progress checks each period to give the right incentives to abate and invest also during the period rather than only at the beginning or the end. Given that climate treaties are international legal constructs in nature, sanctions, arbitration and other real enforcement mechanisms have to be in place to secure compliance. Also trade issues, involving competitive concerns of countries with and countries without strict environmental regulation have to be dealt with at the international level. Although enforcement and trade is beyond the scope of this text, it is interesting to note that a credible and working enforcement mechanism is a necessary condition for a good climate treaty and is able to diminish uncertainty about the

[10] The positive experience gained by the US through the SO_2 emissions trading regime, established through the Acid Rain Programme of the Clean Air Act in 1990, should not be underestimated here.

[11] Currently, the discussion focuses on reforming the clean development mechanism, especially the CDM institutions and the approval system. However, consensus among carbon-related businesses is to maintain the CDM as a tool to reduce greenhouse gases.

environmental impact of the treaty.[12] Ultimately, the uncertainty about the concrete policy framework affects the price and volatility of carbon commodities, which is discussed in the following part after a brief introduction in the carbon market.

3. The state of the carbon market and the influence of real and perceived uncertainties on prices of carbon

3.1 The regulatory framework of the carbon market

At the highest level the Conference of the Parties and the Meeting of the Parties (COP/MOP) shape current and expectations about future climate policy, but does only have legally binding power where the treaty has conferred such authority. The meetings take place once a year and give important signals for market participants. However, also decisions not taken or delayed by the COP/MOP can impact the market severely, depending on the respective issue. In the Kyoto Protocol, COP/MOP specified three distinct carbon commodities[13]:

- Assigned Amount Units (AAUs). When the allocation of AAUs was decided in the negotiations leading to the Kyoto Protocol, Russia and Ukraine and countries of Eastern Europe got emission targets comparable to OECD countries. However, the economic transition and the related closure of heavy industries which occurred during the 1990s led to emissions decreases of 40 – 70%. The overall surplus of these countries, the so-called hot air is estimated at 5-7 billion t CO_2 eq.. Its initial purpose was to provide the US with an easy way to reach its Kyoto target by agreeing on a bulk transfer of "hot air". This bargain did not work and the "hot air" is about twice to three times as large as the combined demand of all OECD countries. Thus, theoretically, the CDM market could be eliminated overnight as the "hot air" can always sell at a lower price than CDM project developers. However, the countries in transition lost several years in setting up the institutions for selling AAUs, while OECD governments were reluctant to buy "hot air" due to expected opposition from non-governmental organizations. This might change towards the end of the commitment period once governments face the need to comply and do not have the budget to buy expensive CERs.

[12] A good enforcement mechanism ensures that the environmental integrity of the treaty is ensured.
[13] Verified or Voluntary Emission Reductions (VERs), which belong to the voluntary market, are not part of the Kyoto compliance market. We will only look at the Kyoto market.

- Emission Reduction Units (ERUs) under Joint Implementation (JI). JI suffered from a late start of the institutions on the UN level and host country problems similar to those encountered for assigned amount unit trades[14]
- Certified Emission Credits (CERs) under the Clean Development Mechanism (CDM). The CDM has the twin objective to reduce emissions and to contribute to sustainable development (SD) of the country in which the project is implemented.

A complex array of institutions has been set up after 2001 to guarantee the twin objective of environmental integrity and sustainable development of the CDM. At the core, the CDM Executive Board (EB) decides about the technical rules and the registration and issuance of CERs for CDM projects.[15] Over time, the EB has created a number of supporting panels[16], including the Meth Panel, the Small-Scale (SSC WG) and the Afforestation and Reforestation (A/R WG) working groups, the Registration and Issuance Team (RIT) and the Accreditation Panel (CDM AP), which provide technical expertise and prepare recommendations for the EB.[17] Since late 2006, a sizeable number of staff has been hired by the UNFCCC Secretariat to support the Executive Board's work. Over time, the rules for formal acceptance of projects under the clean development mechanism have been elaborated by these institutions. In addition, on the private side project developers, financial institutions, Designated Operational Entities (DOEs), Designated National Authorities and local governments depend and interact with the rules established by the EB.[18] A visual representation of the CDM institutions can be seen in Figure 1 below.

[14] Joint Implementation projects can generate ERUs from 2008 onwards.
[15] The CDM Executive Board is following the guidelines decided by the Conference and Meeting of the Parties (COP/MOP) and is fully accountable to COP/MOP (3/CMP.1, Annex, paragraph 5)
[16] The CDM AP and the Meth Panel was established by EB 3; the A/R WG at EB 14 (Annex 8); the SSC WG following Decision 21/CP.8 in New Delhi, 2002 and the EB-RIT at EB 29. The Small Scale Panel had a short existence between April and August 2002, met three times and drafted simplified modalities and procedures for small scale projects.
[17] The Kyoto market developed a whole array of new terms and abbreviations. A glossary of terms is attached at the end of this article for reference.
[18] Another challenge that can arise from such a multi-layer structure is the anti-commons problem, which means that certain players can delay progress if it is in their (rent-seeking) interest follow such a strategy. However, the rent-seeking argument loses some momentum as the governmentally established entities and their private counterparts are under high critical scrutiny by the public and the media (Buchanan and Yoon, 2002).

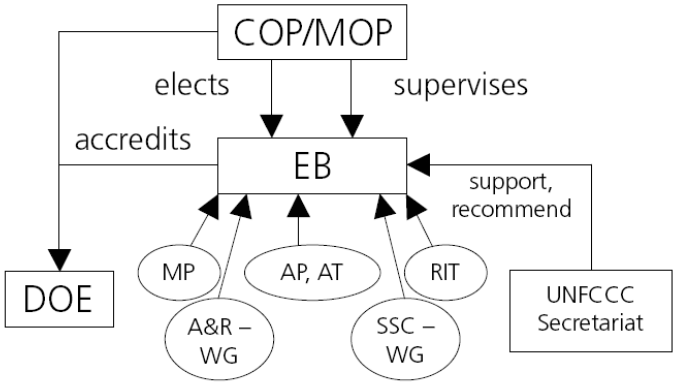

Figure 1: CDM institutions Source: Michaelowa et al. (2007)

Since 2001, the market for CERs has been constantly growing. The main driver has been that CERs can be sold into the EU Emissions Trading Scheme through the EU linking directive (2004/101/EC). The linking directive governs the imports of certified emission reductions and emission reduction units for compliance under the EU ETS; the import of AAUs is not allowed. Until late December 2010, 2700 projects had been registered, 500 million CERs issued and 1.9 billion CERs are expected until 2012 from these projects. Furthermore, over three thousand more projects are in the pipeline.[19]

Despite this success, due to the multiple institutions and participants involved in the CDM project cycle, different degrees of uncertainty pervade the market. An initial uncertainty in the CDM market was whether so-called "unilateral" projects are allowed, i.e. projects that are fully financed and organized by an entity from a developing country. The decision of the CDM Executive Board in May 2005 to allow unilateral projects immediately triggered a strong inflow of projects. While previously only a handful of projects had been submitted every month, within 6 months 100 projects per month came in. This unexpected surge stretched the CDM institutions. Members of the EB had to check all the submitted projects themselves. As they put faith into the validators, only 6% of projects submitted for registration in 2005 were put under review and 1% rejected. Therefore, project developers expected that once a project is validated, it achieves registration. However, the EB set up a second layer of scrutiny in 2006, the Registration and Issuance Team whose experts check the validation report and Project Design Document (PDD) for conformity with CDM rules. In 2006, rejection rates increased to 3%. In 2007, the revenues from the administration fee paid to the EB allowed hiring of a substantial number of support staff, which does a third level check of documentation. In 2007, rejections jumped to 8% and they increased to 10% in 2008

[19] In a recent report validators (so-called Designated Operational Entities - DOEs) have stated that more than hundred projects that are currently in the validation phase will never reach registration due to additionality reasons. However, the data remains confidential for reputational issues of the respective project developers, who handed in the project (Dornau 2008).

and 2009. Uncertainty of project developers regarding registration of a project proposal has thus increased substantially.

The interaction of CDM institutions has an important impact on the investment and planning security of the system. This interaction will be assessed in section 4 of this chapter.

3.2 Pricing of emission credits

Differences in perceived uncertainties generated differences in pricing of different greenhouse gas market units right from the beginning. We show this by some examples before starting a systematic discussion why prices have not yet converged. Before the Kyoto Protocol entered into force, prices for certified emission reductions from CDM projects reached only 3 $. When the European Union Emissions Trading Scheme was decided, the price for EU allowances established itself at a much higher level – initially 8 € and later up to 30 € as the EU ETS was seen as a stable source of demand. The acceptance of CERs in the ETS generated certainty about their use and an increase in price followed. The EU Commission's threshold for the use of Kyoto Mechanisms credits for compliance is unlikely to be binding, but has been used as an argument for a price discount of Kyoto credits compared to a EUA. For a long time, the lack of the "International Transaction Log" (ITL), which is required for transferring Kyoto units between registries of different countries has also been used as an argument for price differentiation between CERs and EUAs.

We see the following three conditions for price convergence of similar commodities: transparency of the market, homogeneity of the product, free and undisrupted trade, following Jepma (2007). The last two conditions are closely linked in case of the EU ETS and the CDM market: We discuss whether they are likely to emerge in the international greenhouse gas market.

In the EU ETS market the transparency of the market is dependent on the information about which installations in the market get how many allowances in which way and if the market has a surplus or a deficit of EU allowances. For example only after the verified and monitored emissions data of EU member states has been published for 2005, market participants realized that EUAs had been over-allocated (Buchner and Ellerman, 2006). This led to a sudden price drop of allowances, from which they never recovered until the end of 2007.

In case of the CDM market, decisions taken by the institutions should be transparent and consistent. This is not always the case. For example, the "completeness check" of the documents submitted for registration of a CDM project by the UNFCCC Secretariat, in early

2008 took on average 2 months. Furthermore, in the first econometric analysis of Executive Board and Methodology Panel decisions, Flues et al. (2008) find that the degree of transparency is higher for methodologies than for project approval/rejection. The authors find that EB membership of the country concerned in project decisions raised the chances of approval in the past. Although it might be helpful in reducing the rejection rate, it is opaque and not supported by any decision of the EB or the Conference of the Parties. On another note, cement blending projects that easily got registered in 2005 now are routinely rejected.

The market for certified emission reductions is characterized by different prices for CERs depending on the stage of the project and the type of contract. Since CERs are generally sold in forward contracts (so-called primary CERs), uncertainty about the creditworthiness of the seller and the buyer, the performance of the technology and the risk of rejection of the project influence the price quoted in a carbon contract. The allocation of these risks to the parties in the contract leads to price differences. The more advanced a project is in the cycle and the closer a project is to issuance by the Executive Board, the higher the CER price. Liabilities play a key role for risky contracts.[20]

Moreover, Michaelowa et al. (2008) show that CDM performance regarding the number of CERs expected for delivery and the actual number issued is substantially different between project types. In an analysis of 203 projects, Michaelowa et al (2008) show that issuance success is between is 15 % for geothermal projects and over 120 % for N_2O projects. More worrying is that also frequently applied project types such as hydro and biomass power plants have low issuance delivery rates in the range of 80-85 %. Also issuance success differs between project developers, with the first large victim of the carbon market being the company AgCert, which specialized on methane recovery and flaring from pig manure. Its 27 projects so far had delivery rates of less than 20 %. The increased awareness regarding the variety of risks – some analysts differentiate between over 70 types of risks – has led to an increased price differentiation according to risk allocation over time (Richardson 2008). Primary CERs with the volume risk fully on the buyer side traded around 3 € until early 2005 and 5 € from 2005. Primary CERs with a firm volume and monetary compensation for underdelivery started to get a premium in 2005 which rose to 3 € in 2006 and 5 € in 2007. Guaranteed CERs, i.e. CER portfolios aggregated by financial institutions with a high credit rating, were available from the second half of 2007 and have traded at a discount of about 1 € to the price of issued CERs, so-called secondary CERs (Capoor and Ambrosi 2008). At the end of March 2008, IDEAcarbon (2008) started a weekly market survey with four categories.

[20] For a good analysis and an overview of how carbon contracts can be structured see Chapter 20 in Streck and Freestone (2005).

The lowest tier has the buyer taking methodology, validation, registration and volume risk and a 50% forward payment. In the second tier, the seller takes the methodology and validation risk. In the third tier, the seller takes the registration risk, while the buyer pays on delivery and in the fourth tier the seller takes the volume risk. The price range within each tier was higher than the average price difference between tiers, showing the influence of project type and host country risks.

The homogeneity of the carbon commodities and free undisrupted trade are related subjects in the carbon trading universe. In principle homogeneity is established by the EU linking directive. In general terms, EUAs and CERs allow its holder to emit one ton of CO_2 eq. or to convert to such a right, respectively. In theory, CERs and EUAs should thus trade at the same price. However, it is notable that even issued CERs, for which no delivery risk exists, do trade at a discount to EUAs. A potential reason could be regulatory decisions, highlighted in Figure 2, by the EU and the EB about the future of the Kyoto market. For example, the UNFCCC announcement in August 2007 that the ITL would become functional in November 2007 led to a substantial drop in the EUA-CER spread. Despite the timely fulfillment of this promise, a registry-related problem remained until late 2008. All transactions of the EU ETS are registered in the CITL (Community Independent Transaction Log). Similarly, all international transactions in the Kyoto system, AAUs, ERUs and CERs are registered in the ITL. While linking the CITL and the ITL had been expected for no later than December 1st 2007, it took until mid-October 2008. This in turn meant that the free trading of EUAs in phase II was inhibited. Some countries, reacting to pressure from emitting interest groups, even refused to issue EUA to their installations before the ITL is linked to the CITL. At the same time, the missing link between the CITL and the ITL also meant that CERs generated by CDM projects could not be used for compliance in the EU ETS. Finally, in mid-October 2008 the ITL-CITL link was completed. The linkage did lead to the expected decrease in EUA-CER spread as can be seen from the figure below.

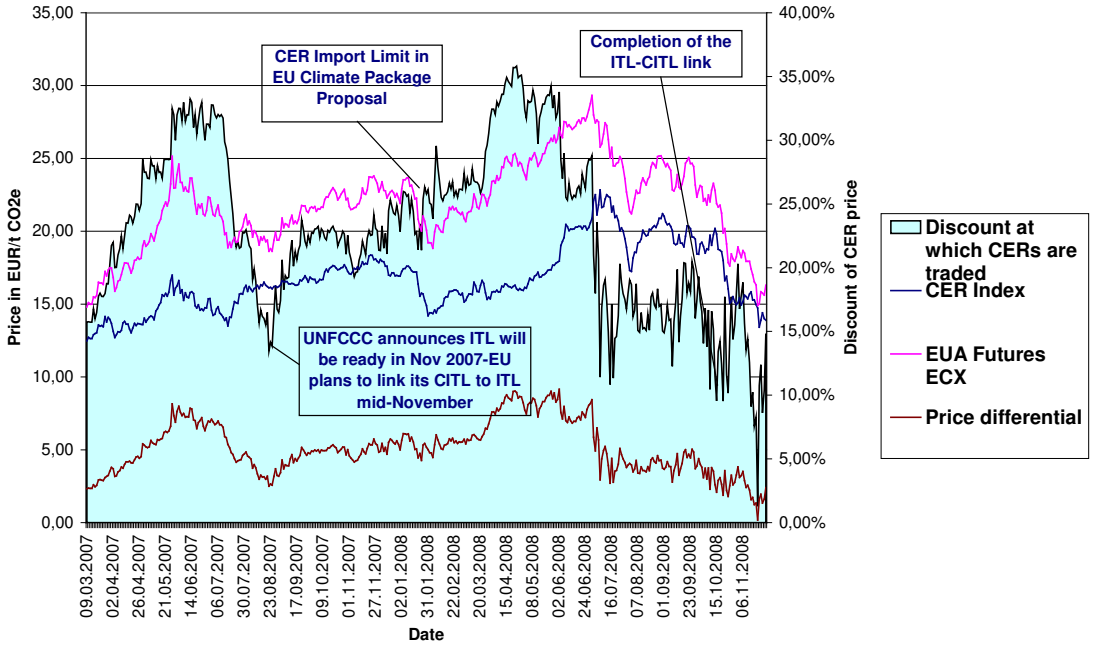

Figure 2: EUA vs. CER prices in 2007-2008 Sources: (ECX, Reuters, Own calculations)

Figure 2 depicts the price of Dec 2008 EUA Future Contracts, secondary CERs and their price differential both in absolute and relative values. Prices for primary CERs are often confidential information and are thus currently not available on a large scale for analysis.

The subsequent arguments discuss reasons for volatility in EUAs and CERs and pricing differences between the two. Volatility in EU allowances stems from multiple factors, where the interaction of supply (the allocation of allowances) and demand (the emissions by covered installations) dictates the price. Moreover, the information and access of market information and expectations by market participants moves the market. As compared to phase I of the EU ETS (not shown in the figure) where an over-allocation of allowances led to a sudden collapse of the EUA price, phase II EUAs established a support line at around € 20/t CO_2 eq. due to stringent decisions by the EU Commission that slashed most allocations. Only when it became clear in October 2008 that the financial crisis would lead to a decrease of heavy industry production, EUA prices fell substantially. Thus, expectations about future EUA demand drive the price. EUA prices fluctuate also in dependence of the amount of external credits that can be used for compliance. In phase II, the European Commission established an overall import limit of 1.4 billion t CO_2 eq. (EU Commission, 2007). As the projected shortage in the EU ETS is about 1 billion t, this limit is not binding. In late January 2008, the Commission announced its intention not to allow any new imports beyond the limit for the time 2013-2020 if the overall EU reduction target was 20%. Only with a 30% target, 0.9

billion t could be imported. Figure 2 shows the sharp increase of the differential between EUAs and CERs after the Commission announcement. Whereas the limit of CER credits is an arbitrary decision, which is at risk of being influenced by interest groups, it should be communicated in a transparent manner to enhance certainty for stakeholders.

The announcement by EU Commission representative Slingenberg that certified emission reductions should be calculated according to very stringent benchmarks, thus leading to a "de facto discount of CERs" did not have an adverse effect on price of issued CERs and EUAs, which have increased in the same time period due to high fossil fuel prices (GTZ CDM, 2008). However, it can cast a chill on the development of new CDM projects.

Pricing in CER forward contract can be set as a combination of a weighted average of various factors, such as the actual EUA price at the time of CER delivery, an indexed price over a pre-specified time period, a fixed price or various combinations of both (Streck & Freestone, 2005). The impact of the choice of parameter can be striking: A contract specifying CER price in terms of phase I EUA price in December 2007 was settled at 0.03 €/CER, as the underlying EUA price had collapsed due to overallocation. Had the contract been determined in phase II EUAs, it would have had to be settled at 23 €.

The pricing of post-2012 credits is another complicating factor. CERs for projects extending beyond 2012 trade currently at a large discount compared to CERs expected to be issued within the Kyoto Protocol commitment period and not many entities buy such CERs. Large buyers such as the World Bank can influence the market by their price offers for post-2012 credits. Capoor and Ambrosi (2007) claimed "uncertainty of compliance value as one aspect" to discount the value of post-2012 CERs and reported prices of 2-4 €. Such low offers by large buyers cast doubt on a credible commitment to a continuation of the current climate policy regime and are even dangerous for the system.

The huge pricing volatility, especially due to regulatory uncertainty, makes it difficult to secure a loan with the CER flows, especially if loan-providers expect the current system to be altered. Generally, the pricing of Kyoto credits depends on a multitude of issues involving energy prices, environmental regulation globally and domestically, risk perception and shifting, the behavior of large players and on decisions taken at the EU and UNFCCC level. At each stage uncertainties can arise if the information revealed and the transparency of the market is incomplete. In the following the interaction of key market participants will be examined in light of their influence on uncertainty in the market.

4. Interaction of key actors in the Kyoto/CDM market and their influence and challenges with uncertainty

In the Kyoto market various actors influence, and are impacted by, uncertainty. External participants shape the rules of the market and internal participants act within the market. However in some instances, external participants, especially if they are large, can impose or change the rules after which they themselves will act.

4.1 External market actors

Governments are involved at the COP/MOP level, but also at the supranational and at the domestic level implementing supportive policies to reach the Kyoto targets. They can directly join or to refrain from the CDM market or link the CDM to domestic policies such as the EU ETS. The duration of the third EU ETS phase has been specified as 2013 – 2020 even before a post-2012 climate policy regime has been decided. The stringency of the third phase - and CER demand, if imports are allowed - depends on the degree of credibility/enforcement of the 20% energy efficiency improvement and 20% renewables targets for 2020. If companies with installations covered under the EU ETS replace them by renewable energy or reduce fossil electricity production due to a reduction in electricity demand, this leads to a reduction in demand for EUAs and CERs.

A counteracting effect is the learning effect in the production of renewables equipment, which increases as more of this equipment is demanded and installed. Moreover, through economies of scale this can also make technology more accessible to CDM project hosts and thus lead to an increase in the supply of credits.

Host governments of CDM projects can influence the functioning of the carbon market by giving project developers and external investors legal, investment and political security and assuring low or no barriers to technological transfer (Ellis and Kamel 2007). Investors demand lower risk-adjusted returns and are more willing to invest in countries where their investments are protected by legally enforceable contracts and regulations. The political and regulatory stability across electoral cycles of host countries is an important issue for all investments including the CDM. Investors and project developers have to be assured that country specific rules impacting the CDM project are not changed retroactively. Similarly, many CDM projects require technology imports. Host countries, which are at the same time producers or even exporters of the respective technology might be inclined to protect their

domestic market. These host countries are in the difficult position to reduce barriers for incoming technology or to give in to domestic interest groups.

Not only on the demand side, governments of large countries can influence the working of the market substantially by their regulatory decisions. For instance, China has set a price floor for CERs.[21] The level of the floor is arbitrary and injects volatility into the market if the decision is not transparent and communicated accordingly. In theory, the effect of a price floor is that if the price floor is below the actual price of CERs, the floor is not binding and is a "safety net" for project developers, which are able to calculate with the price floor as the "worst case" scenario. If the price floor is exactly the price observed in the market, nothing happens. If the price floor is above the market price, supply of CERs exceeds demand, which would, in the absence of the floor, theoretically lead to a price decrease to the equilibrium level. However, the expected effect is that project developers are discouraged from producing CERs for which there is no demand. This is of course only possible if no other CER suppliers can enter the market, i.e. it requires control of a sufficient share of CER demand. Thus, price floors set unilaterally by governments of major CER suppliers are an important incentive signal for project developers and investors.

Non-governmental organizations – both in host and industrialized countries – can oppose CDM projects due to attainment property rights of persons and communities in host countries. The displacement of people, and their income-generating activities by CDM projects is not in line with non-governmental organizations' interpretation of sustainable development. Project developers ignoring the awareness-raising power of non-governmental organizations might face unwelcome surprises, as already seen in the context of CDM projects in the palm oil sector. These projects have difficulties to find buyers for their CERs.

The unpredictability and interaction of decisions taken at the government level of Annex B countries increase the general uncertainty level for the Kyoto mechanisms. Decisions taken at the domestic level but having an impact on the global functioning of the market, should be communicated clearly and in a transparent manner, and carefully implemented as large player can have severe impacts on the market.

4.2 Internal actors

[21] China is very supportive of its CDM project developers, e.g. by providing a standard electricity grid emissions factor and introducing a maximum consultant fee for PDD development. On the other hand, the Chinese government utilizes China's market power to tax CER revenues, e.g. HFC-23 by 65 %, as long as this does not adversely impact China's market position.

Project developers, as the name suggest, plan and develop projects. They are extremely vulnerable to uncertainty in the market. Many projects have expected crediting life cycles from seven to twenty-one years, well exceeding the Kyoto commitment period ending in 2012. Thus, project developers need to assure a stream of CER flows that enables them to finance the respective project. This situation has a harmful effect on the additionality of projects: Since project developers cannot calculate with streams of CER cash-inflows post-2012, or at least can currently not be assured a high enough price of CERs, additional projects are crowded-out by non-additional projects. Even if the EB and its panels are able to sort out non-additional projects, it increases the transaction costs of the system. The shift in preference by project developers to non-additional projects depends on the risk aversion and the possibility to take risk on the balance sheet of project developers (see also Lütken and Michaelowa 2008, for incentives of financiers). Large players have an advantage in comparison to smaller players, as it can be assumed that the former project portfolio is more diversified and exposure is smaller in comparison to the latter, all else equal.

Buyers and sellers naturally have opposite incentives. Buyers want to buy at a low price and sellers are looking to sell at a high price. Sellers, such as project developers in unilateral CDM or other project partners in multilateral CDM, can engage already early during the CDM project cycle in the sales of CERs. By selling CER forwards, sellers can minimize their risk, but receive a lower price for their CERs. Buyers in such a transaction receive a low price but carry specific risks such as delivery, technology and regulatory risk.

As buyers can buy carbon credits for various reasons such as immediate compliance, future compliance, and pressure from institutional and private shareholders[22], also the exposure of a contract not fulfilled is different in the above cases. It can be assumed that exposure is highest for transactions used for immediate compliance and lower for transactions to please shareholder demands of reputational image of one´s company. Stock listed companies not complying with a regulation can be punished both by the regulator and the shareholder.

In theory, company buyers under a compliance obligation should compare the price of the compliance tool to the cost of installing alternative cleaner production or energy generating technology. However, faith of the companies in long-term binding climate policy instruments remains limited. Electricity utilities continue to invest in coal-fired plants, which have an estimated life time of 30-40 years. This is well beyond the reach of current global and domestic climate policy. Therefore, it seems that utilities have substantial doubt in the seriousness and credibility of climate policy and continue with investments that do not deviate

[22] The threat of environmental litigation can also be an incentive for firms to engage in purchasing CERs (Streck and Freestone, 2004).

substantially from business-as-usual practices.[23] A widely touted alternative for coal-fired plants is to implement carbon capture and storage (CCS) for new plants or as a retrofit for old ones. The technology is currently still in the testing phase, however, already now energy providers are lobbying for subsidies to install CCS. Without subsidies, CCS-equipped plants are expected to be more expensive than alternative renewable energy sources. CCS could influence the CDM market if it gets cheap enough to be competitive at the future CER price or if widespread use of CCS in industrialized countries reduces power plant emissions and the CER demand.

A third party, intermediaries and traders, are linking buyers and sellers and help to make the market more efficient since intermediaries are able to gather more information than rational individual participants would do on their own. With this information intermediaries can time and structure the trades of carbon credits according to the market setting, and at the same time hedge themselves against risks in the market place. Traders have various income streams. They gain through arbitrage with the price differential between EUAs and CERs, through a long (short) position in a bullish (bearish) market and through the commission fee. More competition in the market for intermediaries and traders induces higher informational efficiency of the market. Therefore, promoting a stable and healthy intermediary market reduces uncertainty. At the same time experience from securities and corporate markets has shown that market manipulations and accounting scandals can lead to a sudden downturn of the market.[24] A careful regulation of trading, market principles and optimized informational requirements decreases the volatility of the market and the risk of a sudden collapse.

Validators and verifiers are responsible for the validation of projects and subsequently of monitoring actual emissions from CDM projects. Although the actual work is not requiring much personnel per se, it requires specific engineering and technological expertise and skills. Assuming a growing CDM market, in order to cope with the increasing demands of projects occurring worldwide, validators and verifiers should start to employ more personnel in the long-run. However, they do not do so because they fear that the CDM market might no longer

[23] Energy providers have profited substantially during phase I of the EU ETS by free allocation of allowances by passing through the opportunity cost of allowances to consumers and other businesses. This has amounted by conservative estimates to about € 8-10 billion (Sijm et al. 2006; Cramton and Kerr 2002; Hepburn et al. 2006; Neuhoff et al. 2006). Therefore, for 2013-2020 full auctioning for allowances to energy providers was envisaged before lobbying by East European states led to some exemptions. Auctioning gives a clear and credible signal to energy generators to change their investment behavior.

[24] The 2008 financial crisis was caused by the sub-prime crisis in which mortgage obligations had been restructured multiple times with the help of Special Purpose Vehicles (SPVs). The restructured product carried a better rating than its inherent risk level would suggest. As many CER transactions are structured with the help of SPVs, it is crucial for the credibility of the market to be assured of the quality and real risk of credits.

exist after 2012. Here it seems that the market does not signal clearly that the demand of CDM-specialized personnel will grow in the long-term.

5. Conclusion and final remarks

Climate policies and the related markets suffer from the inherent uncertainty that is generated by political decisions. Market participants and governments did not know for a long time whether the Kyoto Protocol would actually enter into force and currently the continuation of the climate policy regime after 2012 is unclear. Moreover, uncertainty is generated through inconsistent application of rules by the institutions governing the market mechanisms, and random or opaque rule changes. Domestic and supranational regulation by big players such as the European Union can send both adverse and supporting signals to the market. Finally, there is an important uncertainty about the quality of mitigation projects and their actual performance, which influences the willingness of project developers and investors to undertake such investments. All these elements of uncertainty influence the carbon market price through changes in supply of and demand for emission credits.

In contrast to markets that trade a tangible commodity, markets for CERs can be created and destroyed with a stroke of a pen. This leads to extreme short-term orientation, rent seeking behaviour and high volatility in market prices. These negative effects can be reduced if climate policy decisions have a long-term nature with clear consequences of non-compliance. Moreover, the markets should be regulated in a transparent manner. A liquid market with many players and different expectations decreases volatility and thus increases "certainty"; it also generates a lobbying potential that will make it difficult to enact political decisions that negatively impact the market. An independent institution overseeing international climate policy, acting like a central bank could be a solution, yet currently is politically unimaginable.

Annex I - Glossary of Frequently Used Terms[25]

Abbreviation and Explanation of most frequently used terms:

AAU	**Assigned Amount Unit**: The quantity of greenhouse gases that an Annex I country can release in accordance with the Kyoto Protocol, during the first commitment period of that protocol (2008-12).
Annex I	**Annex I Parties:** The industrialized countries listed in this annex to the Convention which

[25] Adopted from Capoor and Ambrosi (2008).

	were committed return their greenhouse-gas emissions to 1990 levels by the year 2000 as per Article 4.2 (a) and (b). They have also accepted emissions targets for the period 2008-12 as per Article 3 and Annex B of the Kyoto Protocol. They include the 24 original OECD members, the European Union, and 14 countries with economies in transition. (Croatia, Liechtenstein, Monaco, and Slovenia joined Annex 1 at COP-3, and the Czech Republic and Slovakia replaced Czechoslovakia.)
CER	**Certified Emission Reduction:** A unit of greenhouse gas emission reductions issued pursuant to the Clean Development Mechanism of the Kyoto Protocol, and measured in metric tons of carbon dioxide equivalent.
CDM	**Clean Development Mechanism:** The mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development by permitting industrialized countries to finance projects for reducing greenhouse gas emission in developing countries and receive credit for doing so.
CITL	**Community Independent Transaction Log:** Each EU Member State has its own national registry containing accounts which will hold the EU allowances. These registries interlink with the Community transaction log, operated by the Commission, which will record and check every transaction.
COP	**Conference of Parties:** The meeting of parties to the United Nations Framework Convention on Climate Change.
CO_2	**CO_2:**Carbon dioxide
DOE	**Designated Operational Entity:** An independent entity, accredited by the CDM Executive Board, which validates CDM project activities, and verifies and certifies emission reductions generated by such projects.
EB	**Executive Board ():** The Executive Board supervises the CDM, under the guidance of the COP/MOP.
ERU	**Emission Reduction Unit:** A unit of emission reductions issued pursuant to Joint Implementation. This unit is equal to one metric ton of carbon dioxide equivalent.
EUA	**European Union Allowance:** The tradable

	unit under the EU ETS. One EUA represents the right to emit one ton of CO_2.
EU ETS	**European Union Emissions Trading Scheme:** The emissions permit trading scheme established by EU directive 2003/87/EC.
GHG	**Greenhouse gases:** These are the gases released by human activity that are responsible for climate change and global warming. The six gases listed in Annex A of the Kyoto Protocol are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N20), as well as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).
ITL	**International Transaction Log:** Verifies transactions (AAU, ERU, CER etc.) proposed by registries to ensure they are consistent with rules agreed under the Kyoto Protocol.
JI	**Joint Implementation:** Mechanism provided by Article 6 of the Kyoto Protocol, whereby a country included in Annex I of the UNFCCC and the Kyoto Protocol may acquire Emission Reduction Units when it helps to finance projects that reduce net emissions in another industrialized country (including countries with economies in transition).
KP	**Kyoto Protocol:** Adopted at the Third Conference of the Parties to the United Nations Convention on Climate Change held in Kyoto, Japan in December 1997, the Kyoto Protocol commits industrialized country signatories to reduce their greenhouse gas (or "carbon") emissions by an average of 5.2% compared with 1990 emissions, in the period 2008-2012.
Non-Annex I	**Non-Annex I Parties:** Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.
PDD	**Project Design Document:** A project-specific document required under the CDM rules which will enable the Operational Entity to determine whether the project (i) has been approved by the parties involved in a project, (ii) would result in reductions of greenhouse gas emissions that are additional, (iii) has an appropriate baseline and monitoring plan.
UNFCCC	**United Nations Framework Convention on Climate Change:** The international legal

	framework adopted in June 1992 at the Rio Earth Summit to address climate change. It commits the Parties to the UNFCCC to stabilize human induced greenhouse gas emissions at levels that would prevent dangerous manmade interference with the climate system.

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